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FAUNAL SURVEY OF NEW ENGLAND. II. THE DISTRIBUTION OF GASTROPOD MOLLUSCS

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ABSTRACT

The New England region of northeastern New South Wales (between 151°20' and 152°30'E and 28°50' and 31°40'S) was surveyed for terrestrial and freshwater gastropods. The distributions of species are related to a grid system with all components within the grid being 5' latitude by 5' longitude. Of the specimens collected, 28 were identified at the species level. The taxonomic status of the remainder is such that further separation beyond genus level based on existing criteria is virtually meaningless and, in one case (Family Charopidae), further separation into genera is doubtful. Thus, the remaining specimens were listed under 10 genera and one family. Comments are made on possible further taxonomic separation of some of these, especially in relation to distributional findings. Distribution maps are presented for 35 taxa, at either the species or genus level. Notes on habitat preferences of the molluscs and relationships between distribution of the molluscs and broad environmental divisions are included. However, it is emphasized that this survey is intended as an initial review of the gastropod fauna and more exacting interpretation of habitat or environmental limitations would require closer attention to the biology and ecology of particular species or groups.

INTRODUCTION

This study formed part of a broad survey to increase the knowledge of the distribution of a number of animal groups in the New England region. The objectives, geographical areas, animal groups, and maps of environmental features and funding of the overall work are outlined by Heatwole and Simpson (1986).

Briefly, the collecting of terrestrial and freshwater gastropods was within the bounds of: longitude 151°20' and 152°30'E and latitude 28°50'S and 31°40'S. Parts of the margins of this rectangular section were not visited as these verged into coastal areas or represented continuations of western plains.

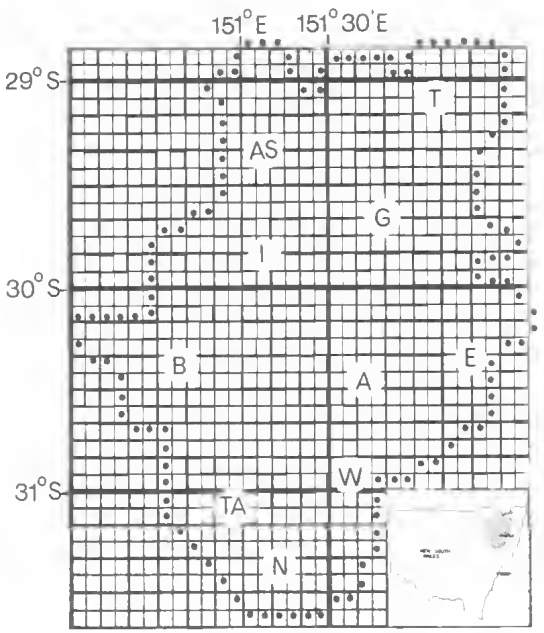

FIG. 1. Collecting grid superimposed on New England region. The area of the survey is enclosed by the solid dots. (Insert shows location of the survey region). **AS** = Ashford, **A** = Armidale, **B** = Barraba, **E** = Ebor, **G** = Glen Innes, **N** = Nundle, **TA** = Tamworth, **T** = Tenterfield, **W** = Walcha.

The region of collection in relation to northeast New South Wales is shown in Fig. 1. The area was accessible from Armidale and contained a variety of climates and habitats: sub-tropical and temperate regions, large altitudinal range of approximately 1,300 metres, differing soils and geology, and vegetation types ranging from undisturbed temperate rainforest to temperate woodland largely cleared for pastoral use.

The survey of gastropod molluscs in this region had the following aims: firstly, to obtain a record of species present in the region and secondly to relate distributional patterns of species to the types of available habitat and to broader environmental divisions across the region. This provides an initial framework for any further analysis between distribution and environment for selected species or groups.

METHODS

All records of species were mapped using the 'Australian Biogeographical Integrated Grid System' (ABIGS) which is outlined in Brook (1977). The system provides a complete grid-cell concept for the presentation of collection data for the whole Australian continent and its use will allow efficient comparisons between biotic distribution maps from different workers. On this scheme, a grid of 5' latitude by 5' longitude was superimposed across the collecting region (Fig. 1). Each one of these cells represents a 'quarter-cell' (the smallest cell) in the ABIGS system and covers approximately 76 km^2 at these latitudes. The ascending size of grid cells in the ABIGS system is designated by increasing line thicknesses on the figure. Presence of a species in any part of a 'quarter-cell' is indicated by the shading of that cell.

A few squares within the designated region were not visited, usually because of difficult accessibility, but these squares were widely scattered and did not affect the determination of distributional ranges for species across the region. In a few squares, collections were made more frequently than in the remainder, usually because personnel on other projects occasionally collected snails in accessible areas near towns. Again, such occurrences did not affect distributional patterns.

On visiting a square, collections were made in the following habitats: under logs, under stones, in flowing water, backwaters and marshes. Leaf litter was searched in the field but samples were not collected for laboratory extraction of fauna. Collecting from trees was only from loose bark, no greater than 2.5 metres high.

Maps of broad divisions of geographical and climatic features across the region are presented in the introductory paper to the New England faunal surveys (Heatwole and Simpson, 1985).

The majority of the collections from this study are housed in the Malacology Department, Australian Museum, Sydney, N.S.W. A reference collection of each species/genus is lodged at the Zoology Department, University of New England, Armidale, N.S.W. The specimens have been mainly preserved as wet collections.

IDENTIFICATIONS

A key has been constructed to facilitate the identification of the terrestrial and freshwater gastropods of the New England region, for both amateur naturalists and researchers alike. Although detailed notes on the species are provided in the text, the key presents a simple method for distinguishing between the more commonly encountered forms.

Characteristics of the live animal as well as shell features are referred to in the key. Illustrations and photographs of a number of the species are presented as an additional aid to users of the key. While the main aim of the key is to simplify the task of identification, it has been necessary to make use of a number of technical terms which may be unfamiliar to readers. Explanation of these terms is provided in a glossary presented at the end of the text. For further information on land snail terminology, Smith and Kershaw (1979) is recommended as a reference.

In a departure from normal practice, habitat characteristics are also used in the key. In particular, the terrestrial and aquatic species are separated early in the key (Couplet 9).

Although every effort has been made to ensure identification to species, a number of points need to be kept in mind.

Firstly, all characters used in the key are based on average adult specimens except where stated otherwise. The number of shell whorls are usually indicative of the age of a shell. Therefore, in any comparison among species using size as a criterion, the number of shell whorls indicating adulthood (or at least when further growth is of no consequence to any comparison) should be specified. In the key, 'adult' usually refers to a shell of 4 whorls or greater. Thus, problems may arise from juvenile shells or shells which are old and excessively worn. Also, shell characters, such as size and shape, do vary within a species and some allowance should be made for this variation when using the key.

Secondly, a number of the groups are poorly known and full scale taxonomic revisions are needed before correct species determinations will be possible. In these cases no attempt has been made to proceed beyond the level of genus and in the case of the litter dwelling Charopidae, family.

Finally, the collection procedure employed during the survey did not include a thorough search of litter. This has not allowed a complete listing of the very small snails which live in this micro-habitat. The groups mainly affected are the Punctidae and Charopidae. However, this will not prevent the user of the key from obtaining the correct familial determination of these snails.

Key To The Terrestrial And Freshwater Gastropod Molluscs Of The New England Region, N.S.W.

1. No external shell, slug-like body 2

   External shell present 9

2. Body separable into visceral mass and foot at posterior end (Plate 2b) .....g. *Cystopelta*

   Body entire 3

3. Triangular mantle around pulmonary aperture. (This triangle can be coloured red, orange, or yellow. The colouring may either fill the triangle or line the edges). Adults commonly 70 mm in length. (Plate 2c) ....*Triboniophorus graeffei*

   Body with saddle-shaped mantle, respiratory orifice on right side, with internal shell 4

4. Mantle with horseshoe-shaped groove ....*Milax gagates*

   Mantle without horseshoe-shaped groove....5

5. Body with markings of leopard-like spots or continuous bands 6

   Body without these markings

6. Large, long body (commonly up to 100 mm in length). Body yellowish-white, dorsally with four or sometimes two bands, mantle spotted (Plate 1a) .....*Limax maximus*

   Body banded or spotted 7

7. Body with dark longitudinal bands on dorsal surface, usually two sometimes three. Mantle banded. Commonly 40 mm in length. Tail has a short keel (Plate 1b) .....*Lehmannia nyctelia*

   Body spotted, without bands. Animal exuding yellowy secretion when live. Up to 100 mm in length .....*Lehmannia flava*

8. When live, exudes white secretion when disturbed. Moves slowly. Broad girth, commonly reaches 40 mm in length (Plate 1c) .....*Deroceras reticulatum*

   When live, no white secretion exuded when disturbed. Slender girth, generally shorter and more rapid in movement when compared with *D. reticulatum*.....*Deroceras caruanae*

9. Terrestrial habitat (Note: some terrestrial snails may be located in recently flooded areas).....10

   Aquatic habitat 31

10. External shell reduced so that animal cannot fully withdraw. Shell thin, ear-shaped, covered to some extent by shell lobes. Animal slug-like, tail with some degree of dorsal keeling. (Several species) (Plate 2a)..... .....g. *Helicarion*

    External shell into which animal can withdraw 11

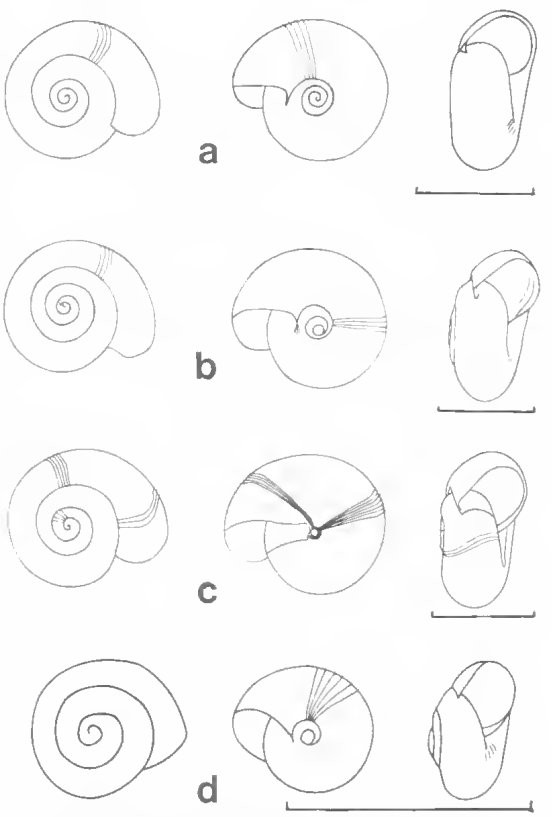

Fig. 2. **a** = Charopid sp.2, **b** = *Elsothera funera*, **c** = *Elsothera inusta*, **d** = *Paralaoma* sp. (Scale lines = 3 mm).

11. Adult shell small, less than 7 mm in diameter 12

    Adult shell greater than 7 mm in diameter 14

12. Adult shell less than 4 mm in diameter, turbinate spire. Protoconch with spiral cords, adult sculpture of coarse radials. Family Punctidae 13

    Shell strongly depressed to discoidal. Spire concave, flat or slightly convex. Protoconch with radial or spiral sculpture, or a combination of both. Adult sculpture of strong radial ribs. (Many species — see text) (Figs. 2a,b,c) .....Family Charopidae

13. Shell moderately depressed, widely umbilicate with coarse radial ribs (Fig. 2d) .....g. *Paralaoma*

    Shell minute, conical, with closely spaced coarse radial ribs .....g. *Iotula*

14. Imperforate as adults.....15

    Umbilicate as adults 20

15. Shell large, depressly conic. Angular periphery to shell in both juveniles and adults. Juveniles umbilicate (Fig. 5a) .....*Thersites novaehollandiae*

    Shell globose 16

16. Shell large with marked colour pattern.....17

    Shell small, adults less than 10 mm in length, with fine growth lines. Spire short, body whorl inflated. No accessory colour pattern.....19

17. Shell very large, with continuous brown spiral bands. Lip strongly reflected (Plate 2e) .....*Sphaerospira fraseri*

    Shell large with interrupted banding 18

18. Shell fragile with conic spire and inflated body whorl. Shell surface smooth. Lip thin (Plate 2d) .....*Brazieresta larreyi*

    Shell solid, globose, with alternate dark and light brown spiral bands. Radial bands of light coloured speckling. Surface malleated (Plate 2g)..... .....*Helix aspersa*

19. Prominent columellar lip. Tree dwelling under bark (Fig. 3c).....*Arborcinea eucalypti*

    Small columellar lip. Ground dwelling, semi-aquatic (Fig. 3b).....*Austrosuccinea nortoni*

20. Shell with widely open umbilicus 21

    Shell with small umbilicus, less than 0.15 times shell diameter.....22

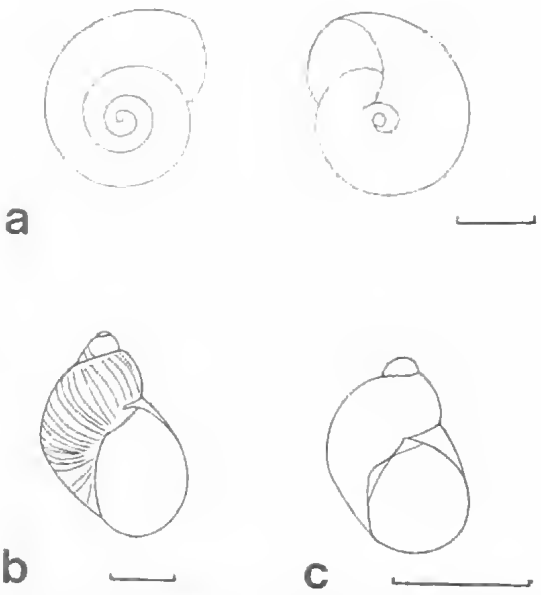

FIG. 3. a = *Saladelos urarensis*, b = *Austrosuccinea nortoni*, c = *Arborcinea eucalypti* . (Scale lines = 3 mm).

21. Shell with strong radial sculpture. Adults greater than 12 mm in diameter (Plate 2f)..... .....*Strangesta capillacea*

    Shell small, yellow almost smooth with few radial growth lines. Umbilicus very wide (Fig. 3a).....*Saladelos urarensis*

22. Shell moderately large with conical spire and prominent peripheral keel 23

    Shell without prominent peripheral keel 24

23. Shell thin, somewhat transparent and shiny with fine radial growth lines. Simple lip (Fig. 4a).....*Nitor medioximus*

    Shell solid with sculpture of fine wrinkles overlying coarse radial ribs. Lip reflected. Colour reddish brown to yellow. Some forms have a dark peripheral band or dark circum-umbilical patch (Fig. 5b)..... .....*Ventopelita mansueta*

24. Adult shell (less than 5 mm in diameter) with a turbinate spire and sculpture of fine radial ribs and fine spiral striae .....g. *Sodaleta*

    Adult shell larger than 5 mm in diameter flattened or globose.....25

25. Shell with flattened spire 26

    Shell globose 28

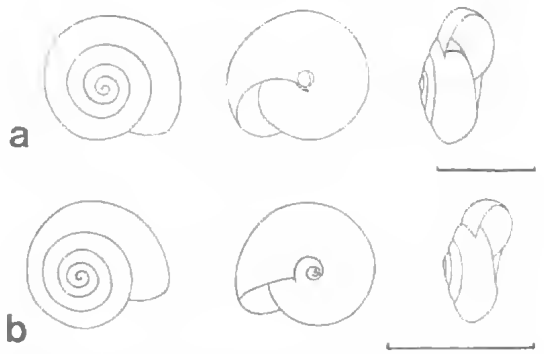

FIG. 4. a = *Nitor medioximus*, b = *Zonitoides arboreus* . (Scale lines = 5 mm).

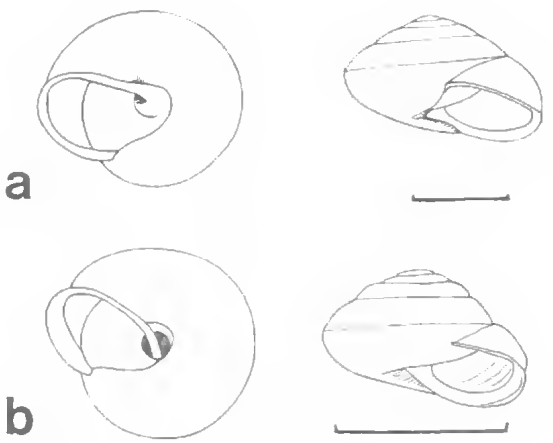

FIG. 5. a = *Thersites novaehollandiae*, b = *Ventopelita mansueta* . (Scale lines = 10 mm).

26. Shell smooth with umbilicus narrow or slightly covered by reflection of columellar lip 27

    Shell shiny, with some degree of radial sculpture and open umbilicus. Colour dark brown (Fig. 4b) .....*Zonitoides arboreus*

27. Shell with narrow umbilicus, columellar edge of lip not reflected.....g. *Melocystis*

    Shell with columellar edge of lip thickened and slightly reflected toward umbilicus ....g. *Expocystis*

28. Shell with hairlike bristles (Several species) (Fig. 6a).....g. *Austrochloritis*

    Shell without hairlike bristles.....29

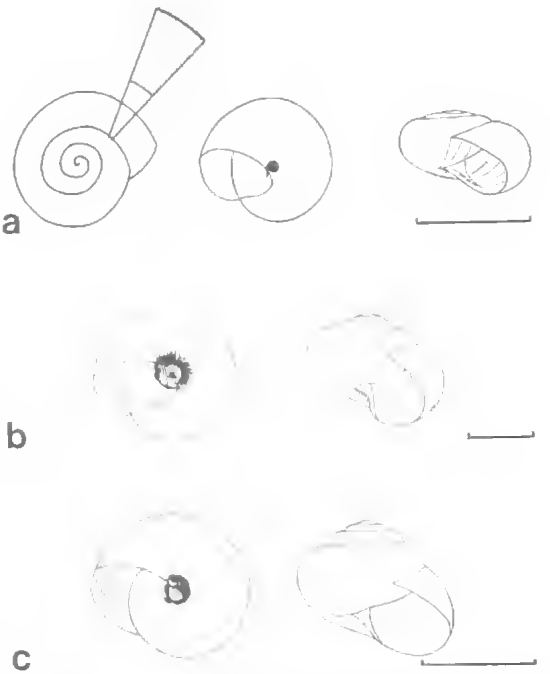

FIG. 6. a = *Austrochloritis* sp., b = *Meridolum gilberti*, c = *Galadistes liverpoolensis* . (Scale lines = 10 mm).

29. Shell greenish-grey, mainly smooth with widely separated pustules. Adults with shell diameter less than 15 mm..*Neveritis aridorum*

    Shell with sculpture or wrinkles, coarse radial growth lines and closely grouped pustules. Colour dirty yellow to brown with accessory colour bands in some forms.....30

30. Adult shell large usually greater than 25 mm in diameter, sometimes with red band below suture and a red patch at the umbilicus (Fig. 6b).....*Meridolum gilberti*

    Adult shell moderately large usually 15 mm in diameter, sometimes with chestnut band below suture and a chestnut patch around the umbilicus (Fig. 6c)...*Galadistes liverpoolensis*

31. Operculum present 32

    Operculum not present.....33

32. Whelk-like shell, strong sculpture (Fig. 7a) .....*Plotiopsis balonnensis*

    Shell small, not whelk-like smooth with strongly convex whorls, and short spire (Fig. 7b) .....*Gabbia australis*

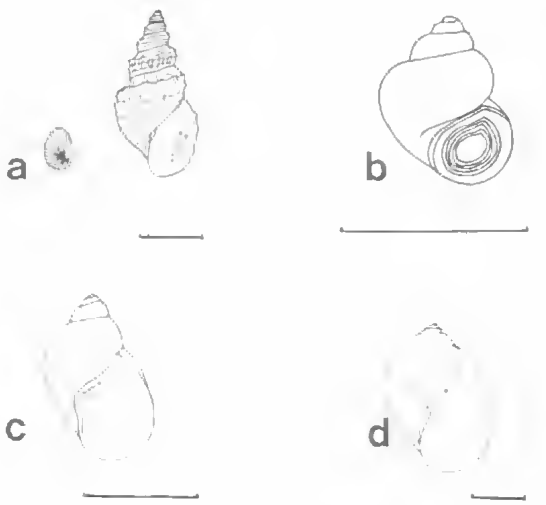

FIG. 7. a = *Plotiopsis balonnensis*, b = *Gabbia australis*, c = *Lymnaea tomentosa*, d = *Lymnaea lessoni* . (Scale lines = 5 mm).

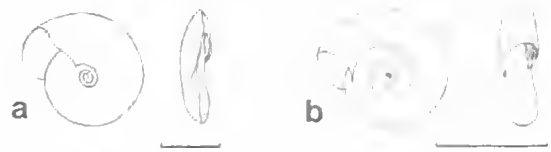

FIG. 8. a = *Gyraulus metaurus*, b = *Pygmanisus pelorius* . (Scale lines = 2 mm).

33. Limpet-like shell, very small, less than 5 mm in length.....*Forsancylus enigma*

    Shell not limpet-like 34

34. Shell whorls in a flat plane with ram's horn shape. Adults small (less than 6 mm in diameter).....35

    Shells whorls not in a flat plane 36

35. Shell with angular periphery and usually light in colour. Aperture lip on left side has marked backward sweep (Fig. 8a)..... .....*Gyraulus metaurus*

    Shell with rounded periphery and usually dark in colour (Fig. 8b)..*Pygmanisus pelorius*

36. Shell dextral, animal with triangular tentacles 37

    Shell sinistral 38

37. Shell ovate, up to 12 mm in length (Fig. 7c) .....*Lymnaea tomentosa*

    Shell globose, up to 20 mm in length. Shell more fragile and body whorl very much inflated (Fig. 7d) .....*Lymnaea lessoni*

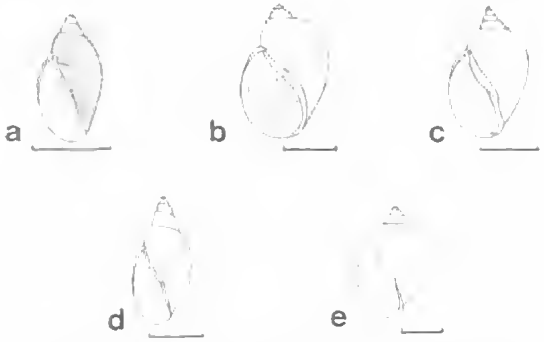

FIG. 9. a = *Glyptophysa cosmeta*, b = *Isidorella* sp., c = *Physastra* sp. 1, d = *Physastra* sp.2, e = *Physa* sp. (Scale lines = 4 mm).

38. Shell with raised spiral ribbing (Fig. 9a)..... .....*Glyptophysa cosmeta*

    Shell without raised spiral ribbing 39

39. Shell without abrupt turn in columella, commonly with periostracal hairs. Animal with pseudobranch on left hand side of body (Fig. 9b).....g. *Isidorella*

    Shell with abrupt turn in columella.....40

40. Animal with pseudobranch on left side of body but without digital processes on mantle. Red tinge to flesh when live (Figs. 9c,d) ....g. *Physastra*

    Animal with digital processes on mantle edge but without pseudobranch. No red tinge to flesh when live (Fig. 9e) .....g. *Physa*

DISTRIBUTION, FURTHER NOTES ON IDENTIFICATION, HABITATS

TERRESTRIAL SPECIES

Family RHYTIDIDAE

Strangesta capillacea (Ferrussac, 1882)
(Plate 2f)

REMARKS

S. capillacea was widely distributed across the New England Region (Fig. 11f). Specimens were collected from under logs and rocks and often were burrowed into the loose earth beneath the logs. Aggregations sometimes occurred but usually single specimens were found. *S. capillacea* is carnivorous and feeds on a variety of

invertebrates. During collecting, specimens were sometimes found eating other snails, notably *Thersites novaehollandiae* and the introduced *Helix aspersa* .

RANGE
N.S.W., VIC.

Saladelos urarensis (Cox, 1866)
(Fig. 3a)

REMARKS
S. urarensis was mainly found in the eastern parts of the survey region (Fig. 11g). Like *Strangesta capillacea* this species is carnivorous. *S. urarensis* was collected from under logs and rocks, usually singly per site. Burrowing was not evident. (Figure 11g also includes those records of shell fragments that did not allow further separation between *Saladelos urarensis* and *Strangesta capillacea* . These are shown by crosses on the figure and it would appear, from the distribution of the two rhytidid species, that the more western records would be *Strangesta capillacea*).

RANGE
NE. N.S.W., SE.Q.

Family CARYODIDAE

Brazieresta larreyi (Brazier, 1871)
(Plate 2d)

REMARKS
B. larreyi was found at three eastern sites, two of these being at approximately 1200 m altitude. Adult specimens reach up to 35 mm in shell length.

RANGE
NE. N.S.W (Dorrigo to the Border Ranges).

Family PUNCTIDAE

The three species occurring in the study area were assigned to the genera *Paralaoma* Iredale, 1913 and *Iotula* Iredale, 1941. However, without a revision of these groups, the assignment of specific names would be fruitless.

Paralaoma spp.

Two species appear to be present in the study area. One with an open umbilicus (Fig. 2d) and another with a narrow umbilicus.

REMARKS
Specimens of these small snails were collected from seven sites in the elevated areas of the central and southeastern parts of the region (Fig. 12d). The small size and cryptic habit of *Paralaoma* spp. made these snails difficult to find under field conditions. More detailed examination of litter samples may have shown a wider distribution pattern.

RANGE
The genus is widespread in Australia with species occuring in Tasmania, Victoria, South and Central Australia, Western Australia, New South Wales and southeast Queensland.

Iotula sp.

REMARKS
One specimen was collected at high elevation (1250 m) on the tableland proper, 14 km east of Guyra. Species referred to *Iotula* resemble *Paralaoma* but are smaller and have a more elevated spire.

RANGE
(Of the genus) NE. N.S.W., SE.Q.

Family CHAROPIDAE

Five species were distinguished in the collections. Two could be assigned to the species *Elsothera funerea* (Cox, 1868) and *Elsothera inusta* (Cox, 1868). These are shown in figures 2b and 2c respectively. The taxonomic status of the Charopidae did not allow for species designations of the other three which have been classed here as Charopid species 1, 2 and 3. (Fig. 2a = Charopid sp. 2).

REMARKS
Elsothera funerea was widely scattered over the region (Fig. 11h) while the records for *E. inusta* (Cox) were restricted to the high tablelands and the eastern areas (Fig. 11i). Distribution of the other three species encountered in the survey are shown in Figures 12a,b,c. Specimens were found under logs and stones and from litter in the field. More detailed sorting of litter would without doubt have resulted in the discovery of further species.

RANGE
The family is widespread in Australia. However, distribution limits of genera and species are poorly known. *E. funerea* and *E. inusta* are both found from central New South Wales to southern Queensland, but the exact limits of their distributions are still to be established.

Family SUCCINEIDAE

Both the succineid species taken during this survey (*A. nortoni* and *Arborcinea eucalypti*) have shell forms that closely resemble the dextral freshwater lymnaeids — especially *Lymnaea tomentosa* ; that is, the final whorl is large and

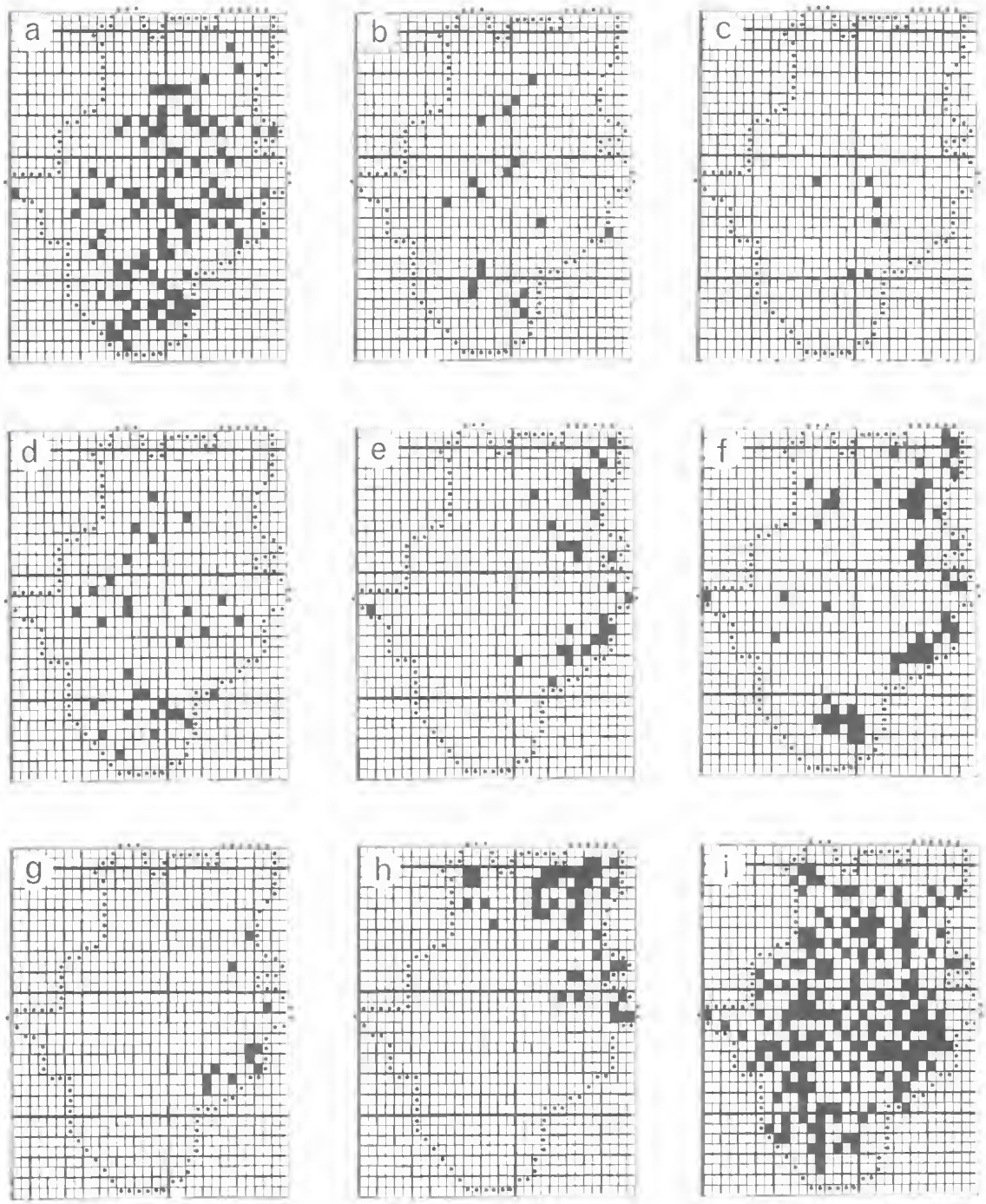

FIG. 10. Distributions of species across the New England region: **a** = *Deroceras reticulatum*, **b** = *Deroceras caruanae*, **c** = *Limax maximus*, **d** = *Lehmannia nyctelia*, **e** = *Triboniophorus graeffei*, **f** = *Austrochloritis* spp., **g** = *Thersites novaehollandiae*, **h** = *Meridolum gilberti*, **i** = *Galadistes liverpoolensis* .

deep (see Fig. 3b,c). Separation of succineids from the lymnaeids is outlined under *Lymnaea tomentosa* .

The assignment of the available material to the two species listed below is one of convenience and should not be regarded as definitive. The group is in need of revision, and is relatively poorly represented in existing museum collections.

Austrosuccinea nortoni (Cox, 1864)
(Fig. 3b)

REMARKS

Collections of *A. nortoni* showed a distribution centred around the tablelands area (Fig. 12e). *A. nortoni* was found under stones and logs. On two occasions, live specimens were taken from non-permanent swampy areas.

RANGE

Coastal and sub-coastal areas of New South Wales.

Arborcinea eucalypti (Cox, 1864)
(Fig. 3c)

REMARKS

Very few records (3 locations, all on the tablelands) were obtained for *A. eucalypti* during the survey. All specimens were collected from under bark on trees. However, systematic searching of trees was not part of the collecting strategy and, consequently, *A. eucalypti* may be more common than was found here.

RANGE

Coastal and sub-coastal area of New South Wales and southern Queensland

Family ATHORACOPHORIDAE

Triboniophorus graeffei Humbert, 1863
(Plate 2c)

REMARKS

T. graeffei was predominantly located in the east (Fig. 10e). The only far western record was in the Mt Kaputar area, a region that is higher and wetter than the surrounding countryside. The juveniles of this species differ from the brightly coloured adults. They are usually grey to cream with two dark longitudinal dorsal stripes. The slugs were generally collected under logs, often in cavities in the soil. Other common habitats were underneath tree bark, under fallen bark around the base of trees, and under artificial shelter (e.g. in refuse dumps) in wooded areas. During showery weather the slugs were often found crawling on the surface of rocks and logs. The species was almost invariably found away from domestic gardens and cleared areas with minor occurrence in partially cleared country. It was not unusual to collect four of five specimens from the one locality.

RANGE

Coastal and adjacent ranges from Wollongong, N.S.W. to Mossman, NE.Q.

Family CYSTOPELTIDAE

The relationships of this family to other groups of land snails is not known. One species was collected in the study area.

Cystopelta sp.
(Plate 2b)

REMARKS

Cystopelta sp. was collected at one site, at approximately 1200 m altitude in the eastern mountain range. The live specimen was 25 mm in length.

RANGE

Species of *Cystopelta* are known from Tasmania, southern Victoria and along the Great Dividing Range in N.S.W. The northward limit of the genus appears to be the Lamington region of the Border Ranges, south Queensland.

Family HELICARIONIDAE

The helicarionids collected during the survey are referred to three genera, *Helicarion* Ferussac, 1822; *Nitor* Gude, 1911; and *Sodaleta* Iredale, 1937. Two other genera, *Expocystis* Iredale, 1937 and *Melocystis* Iredale, 1937, although not encountered in the present survey, are known to occur in the region and are included in the key for completeness.

Helicarion spp.

Iredale (1937) assigned the helicarionids with vitriniform shells of eastern Australia to several genera — *Helicarion, Vercularion, Fastosarion* and *Parmacochlea* . Iredale (1941) added *Peloparion* and *Desidarion* and raised *Parmavitrina* (previously a sub genus of *Vercularion*) to generic rank. With the exception perhaps of *Parmacochlea* , any attempt to assign species to these groups on the basis of external characters alone, is a futile exercise. Future work on the group may establish sound anatomical criteria for generic separation. In the absence of such data, the authors have adopted a conservative approach and assigned species to the genus *Helicarion* , here used in a broad sense to include all species occurring on the east coast which possess a vitriniform shell with the exception of those species previously assigned to *Parmacochlea* .

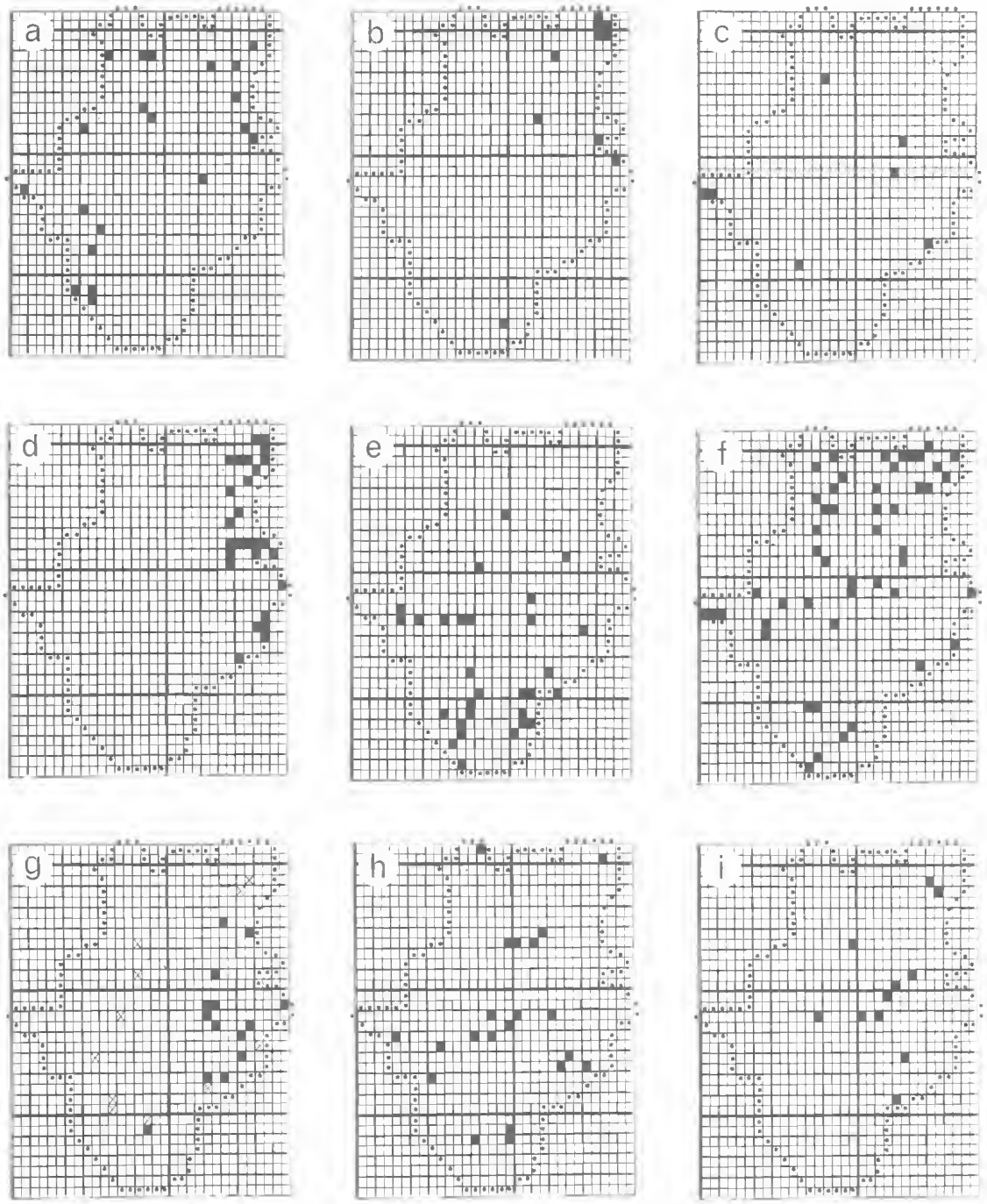

FIG. 11. Distributions of species across the New England region: **a** = *Neveritis aridorum*, **b** = *Ventopelita mansueta*, **c** = *Nitor medioximus*, **d** = *Helicarion* spp., **e** = *Helix aspersa*, **f** = *Strangesta capillacea*, **g** = *Saladelos urarensis* (and unidentified shell fragments x), **h** = *Elsothera funerea*, **i** = *Elsothera inusta* .

Several species were distinguished among the collected material. However, a large number of species are known to occur along the east coast of Australia and only a revision of the group will permit correct species identifications to be made.

REMARKS

The species had a pronounced easterly distribution in the higher, wetter areas of the New England region (Fig. 11d). Specimens were found under logs and a variety of debris, and were not common in areas cleared of trees. Numbers in the field varied from isolated specimens to 5–20 specimens under one log. A typical specimen is shown in Plate 2a.

RANGE

(Of the genus) East coast of Australia from Tasmania to Cape York (latter locality based on specimens in Queensland Museum).

Nitor medioximus Iredale, 1941
(Fig. 4a)

REMARKS

The few records from the survey were widely scattered over the region (Fig. 11c). Specimens were found in moist situations, under logs and rocks.

RANGE

New England Region and adjacent coastal areas, N.S.W.

' Sodaleta ' sp.

This genus is currently undergoing revision by one of the authors. The status of the genus is in some doubt and this reference should be regarded as tentative.

REMARKS

Specimens were collected at only two sites, one in an eastern mountainous area, the other on the tableland.

Family ZONITIDAE

Zonitoides arboreus (Say, 1816)
(Fig. 4b)

REMARKS

Specimens were collected from only four sites in the centre of the survey region. All collections were from under various forms of shelter in domestic gardens and yards. The distribution of *Z. arboreus* over the region was probably much wider as domestic gardens in all areas were not searched. The species was abundant where it occurred.

RANGE

N.S.W. (Sydney and New England area), QLD (Brisbane and Cairns area). Introduced.

Family MILACIDAE

Milax gagates (Draparnaud, 1801)

REMARKS

This slug was collected at only three sites, all sites being away from human habitation, on the tableland. *M. gagates* is a medium-sized slug, adults reaching about 50 mm in length. The body is darkly coloured and has a distinctive dorsal keel from the tail to the posterior edge of the mantle.

RANGE

N.S.W., VIC., TAS., S.A., SW.A. (Introduced).

Family LIMACIDAE

Van Regteren Altena and Smith (1975) revised the composition of the milacid and limacid fauna of Australia, and the treatment presented here, closely follows their presentation. Members of both families are introductions to Australia and the species are largely confined to suburban gardens and other areas modified by human settlement. Their distribution and abundance in the New England region is indicative of the disturbed nature of the area.

Limax maximus Linnaeus, 1758.
(Plate 1a)

REMARKS

Occurrences in the New England region are shown in Figure 10c. *L. maximus* was found in thick vegetation and under logs. Specimens were taken in both domestic gardens and in cleared areas. They were not found in uncleared areas. Usually, only a single specimen was found at the one collecting site.

RANGE

N.S.W., VIC., TAS., S.A. (Introduced).

Lehmannia (Lehmannia) nyctelia (Bourguignat, 1861)
(Plate 1b)

REMARKS

L. nyctelia had a scattered distribution over the New England region (Fig. 10d). Specimens were collected from under timber and rocks. It was common in gardens and in the open; it was found only in cleared areas. Generally it was in small aggregations, single specimens being collected on rare occasions.

RANGE

SE.Q, N.S.W., VIC., TAS., S.A., W.A. (Introduced).

Lehmannia (Limacus) flava (Linnaeus, 1758)

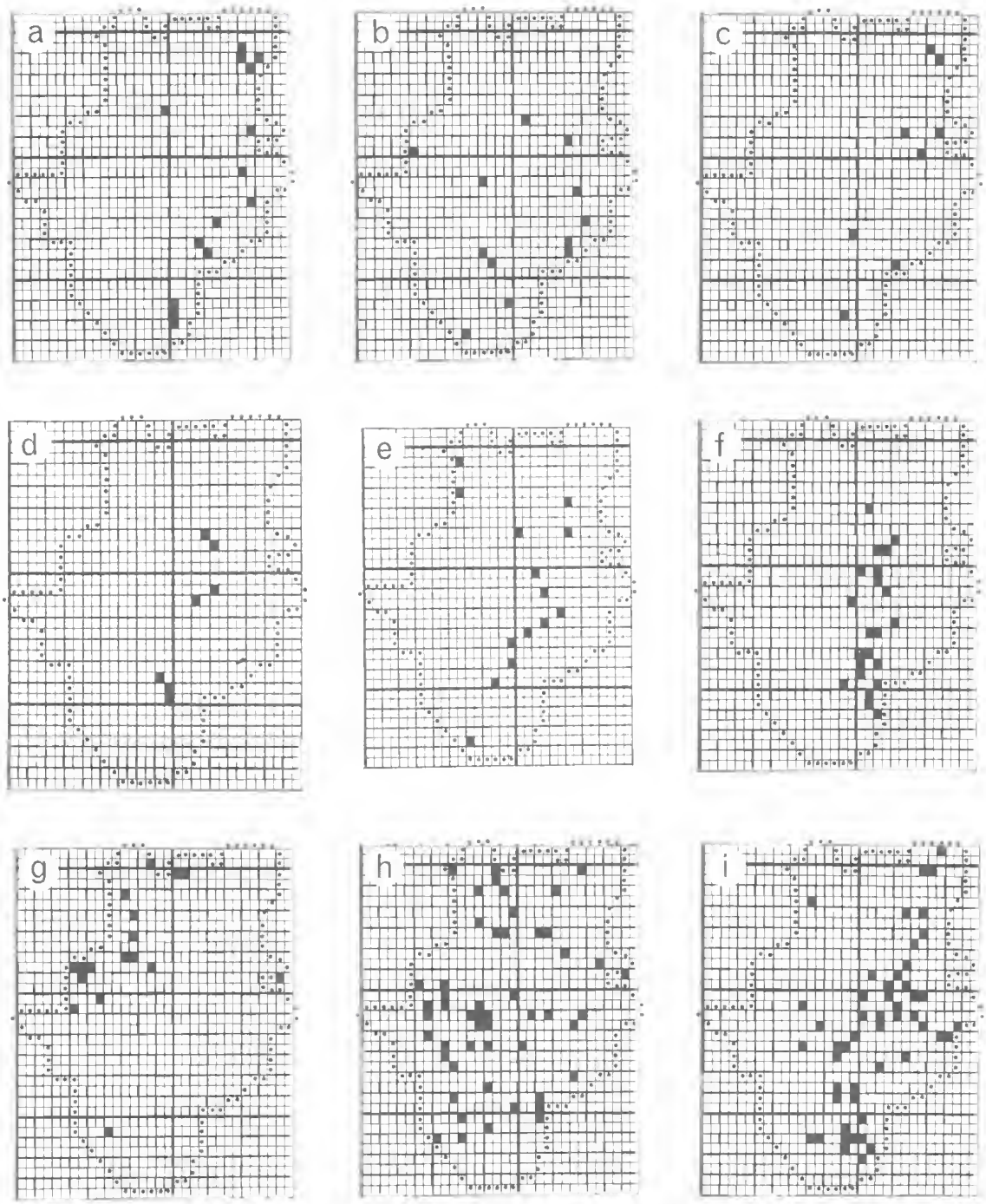

FIG. 12. Distributions of species across the New England region: **a** = Charopid sp. 1, **b** = Charopid sp.2, **c** = Charopid sp.3, **d** = *Paralaoma* spp., **e** = *Austrosuccinea nortoni*, **f** = *Gabbia australis*, **g** = *Plotiopsis balonnensis*, **h** = *Lymnaea lessoni*, **i** = *Lymnaea tomentosa* .

REMARKS

L. flava was collected only once, in a domestic garden in Armidale. Normally a large species (up to 100 mm long), the specimen collected in Armidale was only 30 mm in length.

RANGE

SE.Q, N.S.W., VIC., TAS., S.A., SW.A., (Introduced).

Deroceras Rafinesque, 1820

Van Regteren Altena and Smith (1975) suggest that two species of this genus (*D. laeve* and *D. agreste*) have been misidentified and probably have not been introduced into the Australian fauna. Two forms of *Deroceras* were collected during the New England survey and, from external characters, they match descriptions of *D. reticulatum* and *D. caruanae* (see Key). The wide range in colouration and reticulated patterning gives rise to the possibility of a third species in this group, possibly *D. agreste* . However, extensive comparisons of internal features would be required to positively assert the presence of another species.

Deroceras reticulatum (Muller, 1774)
(Plate 1c)

REMARKS

D. reticulatum was found to be very common across the New England region (Fig. 10a). *D. reticulatum* was virtually restricted to areas of human activity. It was very common in domestic gardens, occasionally being found in very large concentrations. In the open, it was common in sheltered habitats such as the underside of logs, in lush grass, and in grazed, cleared and burnt-out areas. It was rare in uncleared areas.

RANGE

N.S.W., VIC., TAS , S.A., and SW.A. (Introduced).

Deroceras caruanae (Pollonera, 1891)

REMARKS

D. caruanae was less common than *D. reticulatum* in the collections although the locations for *D. caruanae* were widespread (Fig. 10b). Typical of an introduced slug, the species again showed a distributional dependence on man's activities. It was most common in gardens and, in open habitats, it was largely restricted to areas of intense grazing and clearing. Under rocks near creek beds was the most favoured habitat away from domestic areas.

RANGE

SE.Q, N.S.W., VIC., TAS., S.A., SW.A (Introduced).

Family CAMAENIDAE

Austrochloritis spp.

Among the many specimens of camaenids which were collected during the survey, were several belonging to the genus *Austrochloritis* Pilsbry, 1891. Species presently assigned to this genus are characterised by possessing a periostracum which is modified to produce hair-like bristles over the shell surface. In the past, they have been separated largely on the basis of bristle length and bristle spacing. Using the same criteria it was possible to distinguish several different 'types' among the material available for study. However, whether these forms represent different species or whether they are variations of one of several species, remains a matter for future investigation. Fig. 6a illustrates the shell form of the group.

REMARKS

The distribution of specimens in the collecting region was two-part with main occurrence in the wetter and higher eastern region and some additional records in the drier north and west (Fig. 10f). Specimens were usually found under logs and stones and were rare in areas cleared by man. They were not found in large numbers, usually only one or two per collecting site.

RANGE

(Of the genus): Coastal regions and adjacent ranges of eastern Australia, from Victoria to Cape York.

Thersites novaehollandiae (Gray, 1834)
(Fig. 5a)

REMARKS

All specimens were found in the eastern high country (Fig. 10g). Nearly all were collected from under logs in forested areas and the species was rare in areas affected by man's activities.

RANGE

NE. N.S.W..

Meridolum gilberti (Pfeiffer, 1846)
(Fig. 6b)

REMARKS

The distribution of *M. gilberti* showed a restriction to the far north and northeast (Fig. 10h). Specimens of *M. gilberti* were almost invariably found on soil surface under logs, which had ample cavity space underneath, particularly in the wetter areas. It was common in partly cleared areas, that is, where timbered areas were in close proximity to a clearing.

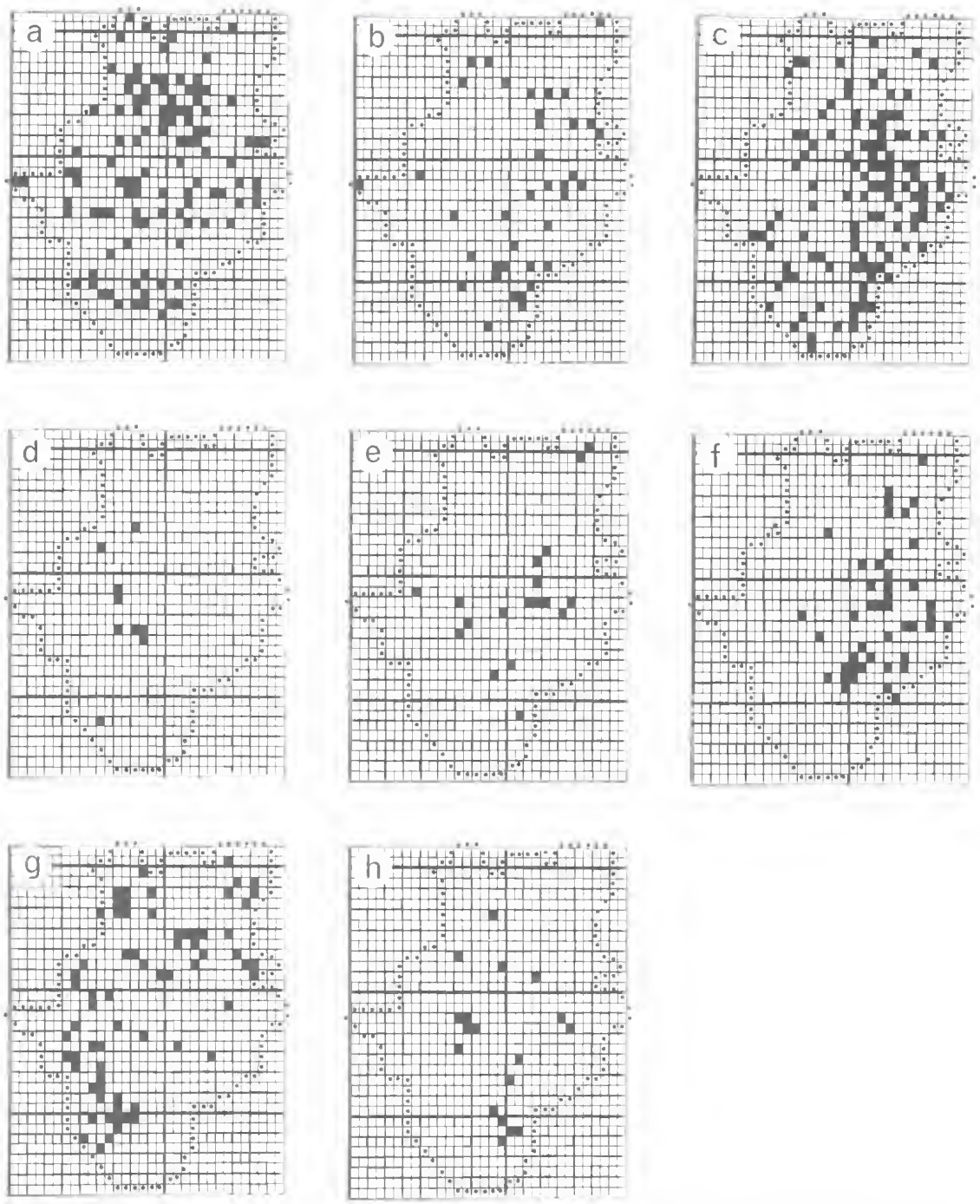

FIG. 13. Distributions of species across the New England region: **a** = *Physastra* sp.1, **b** = *Physastra* sp.2, **c** = *Isidorella* sp., **d** = *Glyptophysa cosmeta*, **e** = *Gyraulus metaurus*, **f** = *Pygmanisus pelorius*, **g** = *Physa* sp., **h** = *Forsancylus enigma* .

RANGE
NE. N.S.W., SE.Q.

Galadistes liverpoolensis (Brazier, 1872)
(Fig. 6c)

REMARKS
G. liverpoolensis was widely distributed throughout the collecting region (Fig. 10i). Specimens of *G. liverpoolensis* were typically found under logs. However, unlike *M. gilberti*, *G. liverpoolensis* often burrowed into the soil beneath the log. Specimens were less common in areas cleared by man and, in particular, were rare in areas of heavy grazing.

RANGE
NE. N.S.W. (Subcoastally).

Neveritis aridorum (Cox, 1866)

REMARKS
N. aridorum was found in the north and in the southwest (Fig. 11a). Like *G. liverpoolensis*, *N. aridorum* occurred under logs where some were found burrowed into the soil.

RANGE
NE. N.S.W..

Ventopelita mansueta (Reeve, 1854)
(Fig. 5b)

REMARKS
V. mansueta was recorded primarily from only a few sites in the northeastern parts of the collecting region (Fig. 11b). Specimens were collected from under logs and rocks in moist situations.

RANGE
NE. N.S.W., SE.Q.

Sphaerospira fraseri (Griffith and Pidgeon, 1833)
(Plate 2e)

REMARKS
S. fraseri was collected from only one site, a forested mountainous area in the east. The shell of *S. fraseri* reaches up to 60 mm in height.

RANGE
NE. N.S.W., SE.Q.

Family HELICIDAE

Helix (Cryptomphalus) aspersa (Muller, 1774)
(Plate 2g)

REMARKS
H. aspersa was found to be widespread over the region (Fig. 11e). *H. aspersa* was prevalent in domestic gardens in centres of human population. The apparent dependence on man's activities for the presence of the species was very marked. The snail uses any available shelter in gardens and surroundings. Outside domestic gardens, the species was found only in some isolated areas that had been cleared and where human and grazing activity was high.

RANGE
Widespread in major suburban areas of Australia. (Introduced).

FRESHWATER SPECIES

Family BITHYNIIDAE

Gabbia australis Tryon, 1865
(Fig. 7b)

REMARKS
G. australis was found to have an unusually compressed distribution in the survey region (Fig. 12f), being located in the mid-tablelands and lower highlands in a north – south pattern. *G. australis* was commonly found on weeds in shallow swamps and was not common in flowing water. It occasionally inhabited artificial dams. *G. australis* often had very large population sizes, single sweeps of a dip net catching up to several hundred specimens.

RANGE
N.S.W., VIC.

Family THIARIDAE

Plotiopsis balonnensis (Conrad, 1850)
(Fig. 7a)

REMARKS
Records for *P. balonnensis* in the survey region were concentrated in the western areas with one record in the east (Fig. 12g). *P. balonnensis* was collected from weed beds of permanent water bodies. Its abundance varied from plentiful (Mole River in the northwest) to an isolated specimen at other sites.

RANGE
Inland and coastal drainage systems of eastern Australia.

Family LYMNAEIDAE

Lymnaea lessoni (Deshayes, 1830)
(Fig. 7d)

REMARKS
L. lessoni was found widely distributed throughout the survey region (Fig. 12h). The

species showed a strong preference for stagnant water. It was occasionally found, sparse in number, in weed beds along the margins of flowing streams. It was abundant in stagnant water bodies with floating vegetation and was often collected from the surface of the water, the animal being supported by the surface tension.

RANGE

Many Australian drainage systems.

Lymnaea tomentosa (Pfeiffer, 1855)
(Fig. 7c)

REMARKS

L. tomentosa was found to be concentrated in the tableland and eastern areas of the survey region. It was sparse in the drier, western areas (Fig. 12i). *L. tomentosa* typically occurred in springs and seepage areas, being present both in and out of the water. Specimens were also taken from very temporary ponds, generally in grassy situations. Man-made dams rarely contained *L. tomentosa* . In its preferred habitat of spring/shallow marsh areas, the species was found with densities of 150–200 per 0.1 m2. Habitat records for *Lymnaea tomentosa* during the survey were in agreement with habitat descriptions by Boray (1964, 1969).

RANGE

Eastern Australia from Tasmania to Queensland.

ECONOMIC IMPORTANCE AND IDENTIFICATION

L. tomentosa acts as an intermediate host for *Fasciola hepatica* the fluke parasite of cattle and sheep. It is the only snail in the New England area that is known to act as a host for the liver fluke. Another lymnaeid snail present in Australia, *Lymnaea columella*, also acts as a host for this parasite. However, *L. columella*, is presently confined to metropolitan areas in Australia where its presence has probably resulted from material imported with aquatic pets (Ponder 1975).

Because of its role in the transmission of *Fasciola hepatica* , a ready means of identifying *L. tomentosa* and thereby distinguishing it from other dextrally shelled snails is important.

L. tomentosa is a small snail with an ovate shell. The spire merges gradually into the body whorl without the abruptness shown by *L. lessoni*. *L. lessoni* in the adult form is larger; in the New England area, specimens often measured 20 mm in length as against 12 mm for large *L. tomentosa* . At this size *L. tomentosa* is readily distinguished from *L. lessoni* particularly because of the greatly inflated body whorl of the shell in *L. lessoni* , However, at smaller sizes, distinction by external characters is less clear. Hubendick (1951) and Boray (1969) have given more detailed accounts of how *L. tomentosa* may be distinguished from *L. lessoni* .

Overall shell shape readily separates *L. tomentosa* from the similarly sized *Gabbia australis*. *G. australis* has strongly convex shell whorls whereas *L. tomentosa* does not. In addition *G. australis* has an operculum and the shell is much more solid than is the case with the fragile shell of *L. tomentosa* .

Members of the succineid genus, *Austrosuccinea* , which sometimes occur in swampy habitats, may be distinguished from *L. tomentosa* by the lack of the columellar fold or twist which is present in lymnaeids. Also, for live specimens, succineid snails have rod-shaped tentacles, whereas *L. tomentosa* has triangular, flat tentacles.

Family PLANORBIDAE

The Australian planorbids are very poorly known. Although a number of generic and specific taxa have been put forward by previous workers the correct allocation of the Australian species will require a revision of the group, not only at the Australian level but also of related forms elsewhere. Thus while Iredale (1943, 1944) proposed several generic taxa for the planorbids, the present study adopts a more conservative approach and allocates the species encountered in the present survey, to fewer, more generalised groups.

Some members of the group are presently undergoing taxonomic revision by J. Walker (University of Sydney) who has provided shell and foot characters to separate the genera *Physastra, Isidorella* and *Glyptophysa* . The two other genera applicable to the New England planorbid species are *Gyraulus* (see Brown 1981) and *Pygmanistus* .

Physastra spp.

REMARKS

Based on shell shape two species of *Physastra* were considered to be present in the survey material. *Physastra* sp. 1, characterised by a relatively low spire (Fig. 9c), was widely distributed throughout the region (Fig. 13a). *Physastra* sp. 2, with a distinctly pointed apex (Fig. 9d), was more predominant on the tablelands and in the east (Fig. 13b). Both species were commonly found in flowing streams and creeks but were rare in dams.

RANGE

(Of the genus). Many Australian drainage systems.

Isidorella sp.
(Fig. 9b)

REMARKS

This species was widespread over the survey region (Fig. 13c). Unlike *Physastra* spp., *Isidorella* sp. was commonly found in dams, overflow ponds and temporary rain ponds. It was rare in flowing water.

RANGE

(Of the genus) Many Australian drainage systems.

Glyptophysa cosmeta (Iredale, 1943)
(Fig. 9a)

REMARKS

This species was only found in the western parts of the survey region (Fig. 13d). Habitats included both flowing streams and temporary ponds.

RANGE

VIC., N.S.W..

Gyraulus metaurus (Iredale, 1943)
(Fig. 8a)

REMARKS

Distribution of *G. metaurus* was predominantly in the middle and southern parts of the survey region (Fig. 13e).

RANGE

NE. N.S.W.

Pygmanisus pelorius Iredale, 1943
(Fig. 8b)

REMARKS

P. pelorius was predominantly found on the tablelands with occurrences becomiug fewer in the drier, western areas (Fig. 13f). As a rule, specimens were taken from thick weed in shallow water around the margins of a larger body of water. It was also found in temporary, well-grassed seepage ponds that were also preferred habitats of *Lymnaea tomentosa* . It was often extremely abundant in some weed beds, over two hundred being caught in a few dip-net sweeps at one site.

RANGE

NE. N.S.W.

Family PHYSIDAE

This largely northern hemisphere group of sinistral freshwater snails has been recorded from several localities in Australia. It is generally considered that these occurrences are introductions. Smith and Kershaw (1979, p. 90) tentatively refer the southeast Australian specimens to *Physa acuta* Draparnaud, 1805, a European species. However, a more conservative approach is adopted in this study.

Species of this family are very difficult to separate from some members of the family Planorbidae on shell characters. Reference must be made to the animal features which are presented in the key.

Physa sp.
(Fig. 9e)

REMARKS

The species was common in both the western and north-eastern parts of the survey region (Fig. 13g). Although it was found in most habitats some preference was shown for overflow ponds of streams. When taken from strongly flowing water, it was often found on tree roots at the edge of the stream.

RANGE

(Of the genus) N.S.W., Central Victoria and South Australia (near Adelaide). Introduced.

Family ANCYLIDAE

Forsaneylus enigma Iredale, 1944

REMARKS

F. enigma was widely spread over the tableland area of the survey region (Fig. 13h). Its small size and near-transparency made detection difficult during collection and it may be more abundant than the records indicate. *F. enigma* was found in streams attached to various types of vegetation.

RANGE

NE. N.S.W.

DISCUSSION

The New England Region, as defined in this survey, encompasses a wide variety of terrestrial habitat types. In the east, small pockets of sub-tropical rainforest interdigitate with bands of temperate rainforest, amidst a broad expanse of open sclerophyll forest. In the west there are large tracts of woodland and unforested areas. Human disturbance of the environment, mainly in the form of land clearing for pasture and cultivation, has affected much of the area with the exception of the more heavily timbered eastern fringe. This disturbance reaches a climax in a number of densely populated commercial centres which are scattered throughout the region.

The aquatic habitats comprise the many rivers, streams and seepages which form six drainages to

the west and a smaller area of four drainages to the east (see Fig. 3 in Heatwole and Simpson 1985). In addition there are many temporary ponds and dams associated with cultivation and grazing.

The historical perspective of the area is one of a long and complex series of changes (climatic, vegetational and physiographic) contrasting with the recent but effective influence of man. The gastropod snails (terrestrial and freshwater) are a mixture of introduced and endemic forms, with distribution patterns that reflect this caricature of the New England region.

The relatively large number of introduced species found in the area is a direct result of a high level of human activity more usually associated with major coastal urban areas such as Sydney, Wollongong and Newcastle. A brief review of the history of the region shows that this activity has had long and decisive effects on the habitats of the region. The influence of European man dates from 1832 and by the late 1830's most of the area had been visited by drovers. Settlement began around 1840 with migration being from the Sydney area via the Newcastle and Upper Hunter River region. Although the area (with the exception of the eastern edge) was never known to be thickly wooded, land clearing began in the 1840's. Swamps, once widespread over the area, were drained as cultivation and grazing became more established.

The survey results show that the endemic terrestrial species are largely confined to the more heavily timbered eastern regions, in contrast to the introduced species e.g. *Helix aspersa* and *Deroceras reticulatum* which are scattered over the region but almost strictly confined to domestic gardens and cleared areas. In general, the endemic terrestrial snails of eastern Australia show a preference for moist forests. It is not surprising therefore that rainforest species such as *Helicarion* spp., *Saladelos ararensis*, *Thersites novaehollandiae* and *Triboniophorus graeffei* are found in the east where the pockets of temperate and sub-tropical rainforest occur.

Of the endemic species, only *Galadistes liverpoolensis* and *Strangesta capillacea* are widely and abundantly distributed over the region. Little is known about *G. liverpoolensis*. However, conchologically it does appear closely related to the *Meridolum* group which tends to be confined to the wetter coastal and sub-coastal areas from southeast Queensland to Victoria. The contrasting distributions of *G. liverpoolensis* and *Meridolum gilberti* (northeast corner of the study area) may indicate a basic ecological difference between the two groups.

The wide distribution of *S. capillacea* is further evidence of the adaptability of this species in the face of habitat disturbance. It is one of very few endemic species which survives in the domestic gardens of Sydney. Although the reasons for its success in such circumstances are not fully known, its carnivorous feeding habits may offer a clue. Whereas other endemic species are detrital feeders and thus rely on the presence of decaying vegetation for their survival, *S. capillacea* would depend more on the presence of other invertebrates. While forest clearing adversely effects the former, it does not necessarily effect the level of invertebrate prey available to *S. capillacea*. In fact, *S. capillacea* is known to prey on the introduced snail, *Helix aspersa* (Simpson 1976).

The introduced terrestrial species, although scattered throughout the region, are largely restricted to domestic gardens and cleared areas. The fact that the introduced slugs, which are not adapted for surviving in dry habitats, are able to persist in the drier western areas, indicates the presence of moist micro-habitats created by domestic activity. The relative scarcity of introduced forms in the forested eastern fringe indicates either an inability to cope with Australia's native vegetation, or the significance of man as a vector for their dispersal.

Thus while disturbances of the environment have had their effects on the distribution and composition of the terrestrial gastropods of the New England region, the results of this survey stress the importance of maintaining the timbered areas of the eastern fringe. On the one hand they form a refuge zone for the majority of the endemic species, and on the other, they show an absence of the introduced elements common elsewhere in the region.

The freshwater gastropods of the region present a slightly different picture. Their distributions are dependent on the availability of suitable aquatic habitats. In this respect man's effect of draining natural swamps has been compensated by the construction of many temporary ponds and dams. The survey results show that a number of species, e.g. *Gabbia australis*, *Isidorella* sp., and *Glyptophysa cosmeto*, are quite successful in these artificial habitats. Only one aquatic introduction, *Physa* sp., is known to occur in the region.

The freshwater snails *Lymnaea tomentosa* and *Pygmanisus pelorius* are particularly important as

they act as intermediate hosts for two live-stock parasties — liver fluke and stomach fluke respectively. In the New England region, stomach fluke is far less serious than liver fluke. In terms of farm management, the survey confirmed the importance of swampy areas as a habitat for these two species; hence, such areas harbour the prime source of parasite infection for cattle and sheep.

During collecting of snails in the New England region, discussion with farmers established that identification of 'fluke-carrying' snails was not clear. Publications by the New South Wales Department of Agriculture, aimed at farmers, have given descriptions of the fluke snail (Dent 1968, 1974). More recently, Campbell (1977) has elaborated on this, outlining distinguishing features between *Lymnaea tomentosa* and other snails.

Both *L. tomentosa* and *P. pelorius* were more common in the wetter areas of the survey region. However, their distribution and abundance would be highly dependent on seasonal climatic conditions, considering the ephemeral nature of a number of their habitats.

In general, the freshwater species do not indicate restriction in distribution to particular drainage systems, relying primarily on the presence of suitable habitats.

The distribution patterns of some of the endemic terrestrial species can be readily aligned with diferences in altitude, temperature, and rainfall — which generally occur along an east-west gradient. Differences in other possible influences on the distribution of terrestrial gastropods (e.g. land use and geology) are more scattered across the region. (See figures for all the above environmental sub-divisions in Heatwole and Simpson 1986). The distribution patterns obtained from this survey provide a framework within which future studies on causal mechanisms of distribution and abundance of particular taxa can be made.

Many promising lines of enquiry have resulted from this survey. (a) What are the reasons for the ecological separation between *Galadistes liverpoolensis* and *Meridolum gilberti*, and within the genus *Austrochloritis* and the species *Plotiopsis balonnensis* ? (b) The climatically similar yet isolated areas around Mt Kaputar and the eastern edge of the tablelands provide an ideal field situation for the investigation of features such as adaptation and speciation in the fauna of the two areas. (c) What features of the biology and ecology of *Physastra* and *Isidorella*, both widespread genera, are suited to their marked differences in habitat preferences (streams and gullies versus temporary ponds and stock dams, respectively)? (d) Does *Strangesta capillacea* exclusively feed on other molluscs, as indicated from the prey observed during this survey? (e) *Gabbia australis* and *Lymnaea tomentosa* both occupied swamp and spring areas, yet extensive populations of the two were not found together. Is there a marked sub-division within this aquatic habitat separating these species or is there some form of competitive reaction between them? (f) The virtual restriction of all introduced terrestrial species to areas under man's influence suggests some strong, common causal mechanism — is it the available food or the refuge areas provided by man?

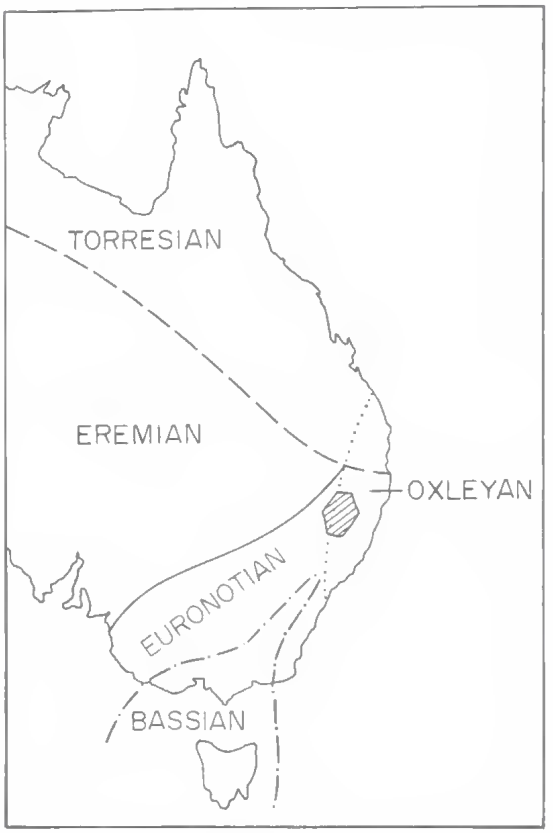

FIG. 14. The New England region (cross-hatching) in relation to the biogeographical divisions for the molluscan fauna of eastern Australia. (These divisions are modifications of those presented by Iredale 1937, 1940 and McMichael and Iredale 1959).

The limited geographic extent of the area of this survey does not allow any biogeographical

analyses to be made. However, an interesting feature of the New England region is that it is situated at the convergence of several biogeographical divisions which have been previously drawn up for the Australian molluscan fauna (Fig. 14). This is a reflection of the ecologically diverse nature of the region.

GLOSSARY OF TERMS

Aperture - The opening in a gastropod shell.
Body Whorl - Last and usually largest coil of shell.
Columella - The column around which the shell whorls are built. Seen externally as the inner edge of the shell aperture.
Conical - Cone-shaped.
Cord - Coarse rounded linear sculpture on shell surface.
Dextral - (Of coiling) right-handed.
Discoid - Disc-shaped
Globose - Spherical or globular in shape.
Imperforate - Lacking an umbilical opening.
Keel - Longitudinal ridge.
Mantle - Membranaceous covering of a mollusc.
Operculum - Horny or calcareous plate which closes the aperture when the animal retracts into the shell.
Periostracum - Thin outer covering of the shell.
Protoconch - The embryonic shell, present at the apex. Usually different in sculpture to adult shell.
Pseudobranch - A secondary gill.
Pustule - Low, small, raised knob of sculpture.
Radial - Parallel to the axis of the shell, running across the direction of the whorls.
Rib - Well defined sculptural ridge.
Shell Lobe - Extension of mantle, sometimes covering shell surface.
Sinistral - (Of coiling) left-handed.
Spiral - In the direction of shell coiling.
Spire - Whorls of a shell excluding the last or body whorl.
Striae - Fine scatched or incised lines on the surface of the shell.
Suture - The line of junction between two whorls.
Turbinate - Top-shaped, but with rounded sides.
Umbilicate - Having an umbilicus.
Umbilicus - An indentation or cavity at the base of the shell.

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PLATE 1.

a = *Limax maximus*, **b** = *Lehmannia nyctelia*, **c** = *Deroceras reticulatum*.

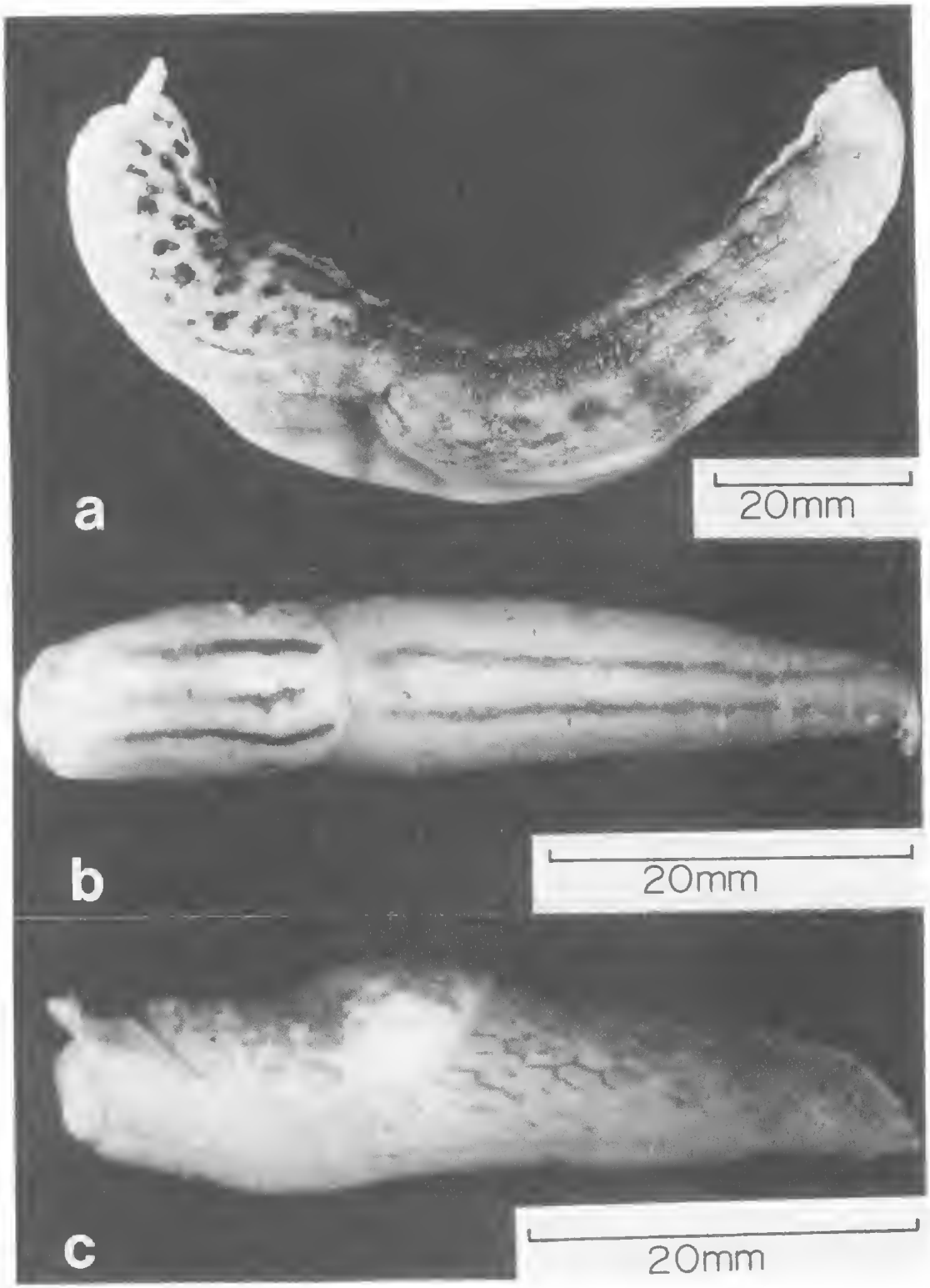
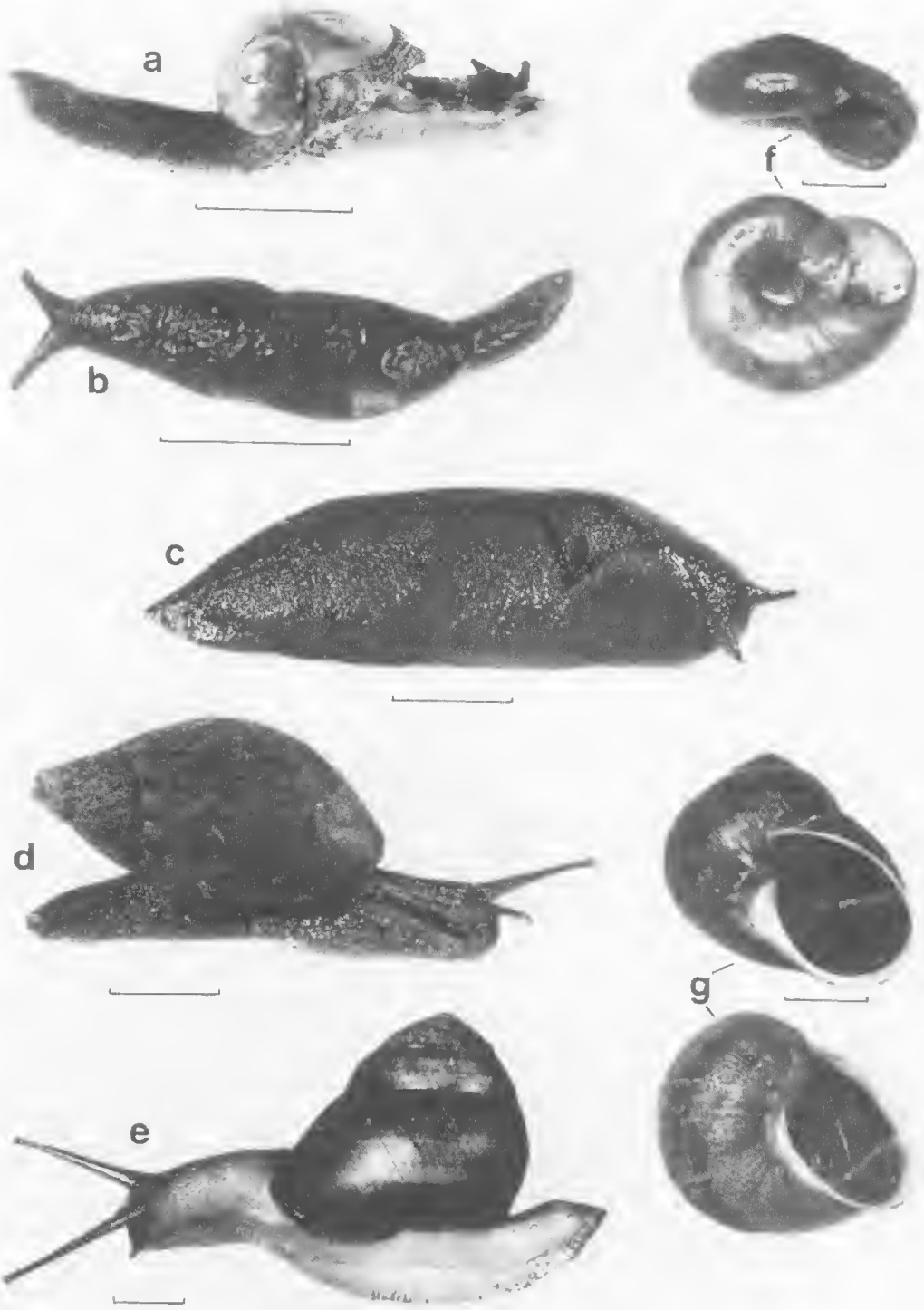

a
20mm
b
20mm
c
20mm

PLATE 2.

a = *Helicarion* sp., **b** = *Cystopelta* sp., **c** = *Triboniophorus graeffei*, **d** = *Brazieresta larreyi*, **e** = *Sphaerospira fraseri*, **f** = *Strangesta capillacea*, **g** = *Helix aspersa* . (Scale lines = 10 mm).


a
b
c
d
e
f
g